

The Impact of the GSE Accounting Scandals on the Increase in Risky Mortgages^{*}

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Abstract

In this paper, I examine the effects of the accounting scandals surrounding Fannie Mae and Freddie Mac (the GSEs) in the summer of 2003. The suddenness and unexpectedness of the scandals make this period a good natural experiment to examine how their market presence affects mortgage lending, both in terms of volume and underwriting standards. I present three novel findings. First, the scandal did have an immediate and dramatic effect on the number of mortgage loans privately securitized as opposed to sold to the GSEs. Second, I find that this had an impact on the mortgage characteristics of mortgages taken out by prime borrowers. Beginning almost simultaneously with the GSE pullback, there was a rapid increase in risky mortgages taken out by prime borrowers, measured by characteristics like poor documentation and the use of adjustable-rates and interest-only mortgages. Finally, I find that the GSE pullback did not appear to have a substantial effect on level of subprime mortgage lending or its underwriting characteristics. Rather, the level of subprime lending was steadily increasing during this period and does not seem to have been affected by the GSE scandal.

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I. Introduction

This paper examines the role of the accounting scandals at Fannie Mae and Freddie Mac, the two largest government-sponsored enterprises (GSEs), and how the impact of those scandals contributed to the increase in risky mortgage lending from 2004-2006. The scandals were both suddenly revealed in mid-2003 and in response the GSEs both cut back dramatically on the amount of mortgages that they purchased from lenders. Because the GSEs can borrow at advantageous rates, they can outbid all other entities when buying mortgages from lenders. Because the GSEs have relatively strict limits on what kinds of loans they will purchase, I argue that they subsidize conservatively-written mortgages, and induce a substitution among borrowers from risky mortgages to conservative mortgages.

This makes for a perfect natural experiment: the GSE subsidy was suddenly withdrawn for exogenous reasons (management fraud). My hypothesis is that this encouraged risky lending: just as nature abhors a vacuum, private lenders rushed in to fill the void left by the GSEs' withdrawal. These private lenders did not offer as attractive terms as the GSEs did on conservative mortgages and borrowers responded by increasing their risky behavior.

The paper is organized as follows. Section II. provides a brief background of GSE activity and the scandal. Section III. provides the results. First, I show that the pullback by the GSEs had a clear impact on the number of mortgages privately securitized. Section IV. examines how the GSE pullback led to more "risk-layering" among borrowers. Borrowers were more likely to use reduced documentation of their income and assets, and take out adjustable-rate and interest-only mortgages. Section V. specifically examines whether the GSE pullback affected subprime lending. Section VI. concludes.

II. Background

The pre-2003 role of the GSEs in the mortgage industries

Fannie Mae and Freddie Mac are government-sponsored enterprises (the GSEs), in that they are privatized government agencies and still have their own regulator and a special type of charter. Their mission is to enhance the flow of credit to the mortgage market by purchasing mortgages from banks and thrifts. Mortgage lenders can either retain the mortgages that they make on their own balance sheets or can sell the mortgages to a third party. They may sell it to one of the GSEs, another federal agency like Ginnie Mae, or a private-sector financial institution. These parties may either hold the mortgage themselves or "securitize" it by placing it in a trust and selling mortgage-backed securities (MBS) backed by cash flows to the trust.

The GSEs have a de facto subsidy from the federal government because the market believes that the government will step in to guarantee their debt if they become insolvent, despite the lack of any specific law authorizing such an action. The GSEs make money in two ways. First, they can borrow at lower rates than banks and thrifts can, so they earn an excess spread on the mortgages they hold. Second, they charge a fee for guaranteeing timely payment of principal and interest on the MBS they sell. Lenders charge lower

interest rates on conforming (eligible for GSE purchase) mortgages than on non-conforming mortgages because they know that they will be able to quickly sell the mortgage to the GSEs. For a more detailed overview of the structure and market role of the GSEs, see Frame and White (2005).

There are two standards that a loan must pass for it to be considered conforming and eligible for purchase by the GSEs. First, it must be for less than the conforming loan limit, which is annually set by the Office of Federal Housing Enterprise Oversight (OFHEO, the GSEs' regulator). Table 1 shows the conforming loan limits for the years included in this study. Second, it must fit within the GSE underwriting standards. The GSEs have strict rules about the kinds of mortgages that they will purchase. They rarely purchase hybrid ARMs, low/no-documentation, interest-only, option ARMs, etc.

There is widespread agreement that conforming mortgages have lower interest rates, providing a strong incentive for borrowers to adjust their borrowing to fit into the GSE guidelines. Ambrose et al. (2004) estimate that conforming loans have yield spreads about 5.5 percent lower than non-conforming loans, after adjusting for risk. Blinder et al. (2006) estimate the jumbo-conforming interest rate spread at 25 basis points. Because of the two-pronged standard for being conforming, I argue that the implicit guarantee acts as a subsidy for conservative underwriting standards for loans under the conforming loan limit. Carlton et al. (2001) show that borrowers clearly make choices between conforming and non-conforming mortgages, both in terms of loan size and loan characteristics (such as fixed vs. adjustable rate, LTV, etc.)

The scandals and regulatory response

The year 2003 was one of both great risk and strong growth for the GSEs, for the same reason: the Federal Reserve set the federal funds rate at a historically low level of 1.00 percent. This induced a huge wave of refinancing. On one hand, this was excellent news for the GSEs: they had never purchased so many mortgages before. On the other hand, the interest rate volatility and prepayments on their existing book of business played havoc with the valuation of the derivatives that they extensively used (and abused) for hedging and, it turned out, earnings manipulation.

In 2003, both GSEs got in trouble with their regulator, the Office of Federal Housing Enterprise Oversight (OFHEO), over accounting issues related to their use of derivatives. Freddie Mac got in trouble in June 2003: it fired several senior executives and was the subject of a criminal investigation. Fannie Mae in late 2003 was under scrutiny but not as exposed as Freddie Mac. However, internally, Fannie Mae's Office of Auditing was performing an Amortization Investigation which raised questions about some of Fannie Mae's accounting standards (OFHEO 2004). See VII. for a timeline of the scandal.

The GSEs severely cut back on their mortgage-purchasing activities in 2004. Meanwhile, the volume of mortgages purchased for securitization into "private label" MBS grew hugely. This may be because the scandal led to increased oversight of the GSEs by OFHEO, Congress, the financial community, and the press. The GSEs had been growing rapidly but scaled down under the attention. Furthermore, they had massive accounting

issues and management had to deal with those issues before growing the business any further.

Although I cannot prove the motivations why the GSEs cut back on their purchases, the evidence is clear. Figure 1 shows that the shift in market share was from the GSEs to private-label securitizers; the market share of portfolio lenders and Ginnie Mae (FHA/VA loans) was roughly constant throughout the period. The GSEs securitized 48 percent of mortgages originated in 2003, but only 31 percent of mortgage originated in 2004.

The rest of this paper is devoted to exploring the consequences of the sudden decrease in GSE activity. I argue that sudden shift in the GSE demand curve induced private-label securitizers to grow their market share, and that this led to principal-agent problems and the origins of the subprime crisis.

The most similar paper to this one is Coleman IV (2008).[†] They find that the GSE withdrawal in late 2003 contributed to the rise in house prices. However, most of the contributions of this paper are not in that one. Their dependent variable is house prices; as such, they do not look at the impact of the GSE withdrawal on mortgage risk characteristics or distinguish between subprime and Alt-A loans like this paper does.

Another related paper is Mian and Sufi (2008). They find that mortgage default rates have risen most sharply in areas that experienced a high amount of mortgage application denials in the 1990s. This is because, they argue, there was a great increase in supply to households with poor credit characteristics. They suggest that “the expansion in the supply of credit driven by disintermediation is responsible for the rapid increase in new loan originations, house price appreciation, and subsequent large increase in default rates.” However, they do not explain why this dramatic expansion in supply occurred, other than to reference Reinhart and Rogoff’s (2008) discussion of liquidity booms and busts throughout history. A related paper (Gerardi et al. 2007) shows that the number of mortgages originated by HUD-designated subprime lenders jumps dramatically each year from 2002 to 2005. Again, however, they do not discuss the effect of the GSE scandal on this, nor do they date a structural break as I do.

III. Econometric Results

Data: LoanPerformance

Most of the data in this paper comes from the LoanPerformance database. This database is produced by the First American corporation and has detailed loan-level information on privately-securitized mortgages. LoanPerformance estimates that the database covers 90 percent of privately-securitized jumbo mortgages and 85 percent of subprime mortgages, for a total of more than \$2 trillion of mortgages. The data contains detailed information on each loan, including characteristics of the loan itself (amount borrowed, the level of

[†] Although Coleman IV (2008) was presented at the ASSA meetings in January 2008, it was not available on the web until July 2008, well after the first draft of this paper was completed.

the interest rate, whether it is adjustable and at what frequency, etc.), the borrower (FICO score), and the collateral (LTV, number of units, ZIP code, etc.).

The database also contains information on the subsequent performance of the mortgages. Several researchers (e.g. Demyanyk and Van Hemert 2008) have used LoanPerformance to study the performance characteristics of privately-securitized mortgages. However, I restrict this paper's analysis to mortgage origination, as opposed to performance.

All the results below were restricted to first liens on single-family homes or PUDs, which make up about two-thirds of the data set.[‡] This type of loan is the GSEs' "bread and butter" and are likely to be most affected by the pullback of GSE activity. The time period spans January 2001 to December 2006. The output is from a 10 percent random sample of the data set created by the author, or approximately 2.5 million loans.

Private-label securitizations

I first demonstrate that the scandals of summer 2003 did in fact have a major impact on GSE securitization activity and that there was clear structural break in the private-label securitizers' market share. I do this by using a difference-in-difference design, exploiting the fact that the GSEs only buy mortgages below the national conforming loan limit. (See Table 1 for the exact limits, which vary by year.) If there were a sudden withdrawal by the GSEs from the market then there should be a sudden increase in the number of loans below the conforming loan limit being privately securitized.

This difference would be greatest directly after the GSEs pull back in their purchases. The loans that the GSEs (and other financial entities) securitize are originated several months beforehand. Sometimes the GSEs precommit to buy loans from mortgage lenders, and sometimes they wait until the lender has accumulated a stockpile of loans that they want to sell. Therefore, loans originated shortly before the scandal hit would not be securitized until later in 2003. Then, behavior should start to adjust in late 2003 or early 2004.

This would not be a perfect test, because some borrowers might actually borrow more and cross the conforming limit line. When the GSEs are active in the market, many borrowers would adjust their borrowing in order to come in under the conforming loan limit and receive a favorable interest rate. As Fannie Mae said in its 2003 Annual Report, "Loan originations... spike to nearly their highest levels right at our loan limit, and then fall off again right after our loan limit. Why is that? It is because buyers of more expensive homes are doing everything possible to come under the loan limit and benefit

[‡] The LoanPerformance data separates single-family homes from "PUD" units. A PUD, or Planned Unit Development, is a planned community in which the units (usually single-family houses) are individually owned and the land and common areas are owned by a homeowners' association. Although I cannot be sure that the PUDs in the data set are single-family homes, most of them are. I include PUDs because they are popular in the rapidly growing areas of western states such as the Phoenix suburbs. PUDs make up approximately 14 percent of my final sample.

from the savings we deliver.” However, after the GSE subsidy is withdrawn, those borrowers would return to borrowing above the loan limit. Nonetheless, as shown below, this does not seem to have been a major factor in practice.

Regression model and results

The dependent variable in my model is the number of originations that were privately securitized each month. The data only has loans that were privately securitized; I do not have data on the entire universe of mortgages originated during this time period. This prevents me from using a logit or other probabilistic model to model the chances of an individual loan being privately securitized or sold to the GSEs. To estimate the impact of the GSE scandals, I estimate a regression of the following form:

$$Y_t = \alpha + \beta_1 T + \beta_2 A + \beta_3 B + \beta_4 A \cdot B + \varepsilon_t \quad (1)$$

where the variables have the following interpretations:

Variable	Meaning
Y_t	The number of mortgages originated in time period t (monthly) and privately securitized
α	Constant
T	Linear time trend
A	Indicator variable that $t > T_0$ where T_0 is the break point when the GSEs reduce activity
B	Indicator variable that the amount of the mortgage is less than the conforming loan limit
$A \cdot B$	Interaction of two indicator variables

I am interested in the coefficient β_4 . If my hypothesis is correct, it will be positive and statistically significant, indicating that the number of mortgages under the conforming loan limit that were privately securitized (as opposed to being sold to the GSEs) jumped significantly after the break point.

Because mortgage characteristics (and more importantly, borrower characteristics) differ with the value of the mortgage, I restrict my sample to a window of plus/minus 20 percent of the conforming loan limit. I purposely chose a somewhat-wide window of 20 percent because

For example, suppose that a borrower in 2003 was interested in borrowing \$325,000, just a few thousand dollars above the conforming loan limit. In order to reach the conforming loan limit, the loan applicant may have scrounged up the extra money from somewhere else in order to come in under the limit (cf. the Fannie Mae quote on page 5). However, the borrower’s ability to do this obviously decreases as the borrowed amount increases. It is beyond the scope of this paper to estimate how the subsidy affects the borrower’s demand function right above the conforming loan limit but 20 percent seems like a reasonable window that is wide enough to capture borrowers who were “legitimately” above the limit but narrow enough to restrict the amount of borrowed money to a band in which borrowers are relatively homogeneous.

Figure 2 shows the difference between the number of privately-securitized loans originated for 20 percent or less below the conforming loan limit and the number 20 percent or less above the limit. It seems like a clear structural break occurred in late 2003, right when the GSEs got into trouble.

If there is a structural break, when did it occur? Bai (1997) and Bai and Perron (1998, 2003; see other references therein) have a series of papers on methods for identifying the number and occurrence of structural breaks, their likelihood, and their standard errors. A break clearly occurs in August 2003. Although the break is clearly visible in Figure 2, I will use the Bai-Perron (BP) method throughout the paper to identify breaks that may be less obvious.

The heart of the Bai-Perron suite of procedures is that finding the number and location of break points that maximize various test statistics: the R^2 for the location of the breaks and one of several, including the F-statistic, Bayesian Information Criterion (the BIC statistic), and a version of the Schwartz Criterion (referred to as the LWZ statistic) for the number of breaks. Bai and Perron show that the number and location of structural breaks chosen by maximizing those statistics asymptotically approaches the true number and location of breaks. Throughout the rest of this paper, the BP test results reported allow for both heteroskedasticity and autocorrelation in the error terms, and for the moment matrices of both the dependent variable and the independent variables to vary between the breaks.

The BP procedure clearly indicates the existence of a structural break in August 2003. The first column of Table 2 shows the output of a difference-in-difference regression using this breakpoint. The coefficient on the interaction variable (labeled “After * Below”) is positive and highly statistically significant.

The coefficient on the interaction variable indicates that, after August 2003, about 675 mortgages more than expected, with origination amounts just below the conforming loan limit, were privately securitized. Since my data is a 10 percent sample, this implies an initial estimate of an extra 6,750 mortgages per month securitized on the private market as opposed to by the GSEs. This number times 36 (to cover three years of extra private securitizations) times a rough average of \$350,000 per loan equals about \$85 billion of extra privately-securitized mortgages. Of course, many of these were refinanced so that was not the number outstanding as of August 2006, but it would be a rough estimate of the volume of securitization (and profits accruing to the underwriters, servicers, trustees, et al.).

All the variables that are statistically significant remain so when using the logarithm of the number of loans as the dependent variable.

The second column of the table shows the results for the same regression in which the dependent variable is the number of loans privately securitized in each state in each month. The control variables include state dummy variables. The interaction variable remains positive and significant.

The third column of the table shows the results of a “kitchen sink” regression. The dependent variable remains the number of loans privately securitized per month per state. Now the control variables include:

- State dummies,
- Interest rates
 - 6-month U.S. dollar LIBOR (the most common index for so-called 2/28 and 3/27 adjustable-rate mortgages, which have fixed interest rates for 2 or 3 years and adjustable for the rest of the 30-year term),
 - 1-year moving Treasury average (the most common index for 5/1 ARMs, similar to above but targeted at higher-income borrowers with a fixed rate for 5 years), and
 - 30-year conventional mortgage rates as surveyed by Freddie Mac, and
- Dummy variables for each month (leaving January as the base variable to avoid collinearity).

All of the interest rate data comes from the Federal Reserve’s H.15 release and is averaged monthly.

The fourth column shows the same regression as column three, but with controls for house prices. The controls are the log of the OFHEO HPI index and the yearly change in that index. These are provided by OFHEO quarterly for every state. Because the data is provided quarterly, the standard errors are “clustered” by quarter. In all of these regressions, the key variable—the interaction of after August 2003 and below the conforming loan limit—is both statistically and economically significant.

Figure 3 and Figure 4 show GSE market activity with the break point of August 2003 highlighted. As you can see, this corresponds almost exactly to the high-water mark of GSE activity. The break is almost exact for GSE MBS issuance, while GSE portfolios kept growing for a few months after their MBS issuance collapsed. As noted before, a time lag exists between when the GSEs purchase mortgages and when they securitize them. If they were suddenly restricted in their securitization activities but had precommitted to purchasing a number of mortgages, then those mortgages would have to go into portfolio instead.

IV. Changes in mortgage characteristics after the GSE pullback

In this section, I examine whether the loss of the GSE subsidy changed the distribution of mortgage characteristics. The GSEs do not have clear thresholds for any characteristics of the mortgage or the borrower other than the conforming loan limit. They use automated underwriting systems that weigh the aspects of a mortgage application for approval. However, several mortgage characteristics that may be attractive to borrowers also make it extremely difficult to get approved for GSE purchase. In this section, I examine the growth of four types of risk-layering: adjustable interest rates, prepayment penalties, interest-only (IO) loans, and reduced loan documentation. Adjustable rates and prepayment penalties transfer risk (interest rate risk and liquidity risk) to the borrower in

return for a lower interest rate. IO loans and reduced documentation let the borrower borrow more money than she would otherwise qualify for based on her credit score or the value of the collateral. (DiMartino and Duca 2007; Agarwal et al. 2007).

Chomsisengphet and Pennington-Cross (2006) focus on credit scores, low down payments (equivalent to high LTVs, discussed later), and prepayment penalties.

The subsidy effects of the GSEs are important. Ambrose et al. (2004) estimate that conforming (GSE-eligible) mortgages have yield spreads about 5.5 percent (about 25 basis points) lower than non-conforming mortgages. Vickery (2007) shows that borrowers are “strikingly” sensitive to interest rate differentials when choosing between fixed-rate and adjustable-rate mortgages. Prepayment penalties are considered risky and subject to abuse; many states have severely restricted their use. However, Elliehausen et al (2008) argue that many borrowers do indeed consciously accept a prepayment penalty in return for a lower interest rate. The attraction of choosing an interest-only loan is obvious: it allows the borrower to purchase a more expensive home by lowering the monthly payment, albeit at the cost of not building any equity. Finally, the mid-2000’s saw an explosion in the use of reduced or no documentation to obtain mortgages (Angell and Rowley 2006). Low-documentation loans (sometimes called “liar loans”) allow the mortgagor to borrow more than her financial circumstances would ordinarily allow her to. Interest-only and low documentation loans are a conscious choice to borrow more than is ordinarily prudent, while ARMs and prepayment penalties are a way for borrowers to absorb risk in return for a lower (initial) interest rate.

In this section, I restrict my analysis to mortgages made to borrowers with FICO scores that would ordinarily qualify them for GSE purchase. I do not include low-FICO score borrowers because they would not have been eligible for purchase by the GSEs anyway and their behavior would not have been affected by the pullback. Although there is no minimum threshold, I used a 620 FICO, which is a commonly-used “rule of thumb” for distinguishing whether a loan is subprime (Keys et al. 2008). (In a later section, I use this FICO cutoff as another threshold to test against.)

It is reasonable to believe that borrower behavior would change during the months following August 2003. The first wave of private-label securitizations would have been those that qualified under GSE standards but were unexpectedly put out to the private-label market because of the sudden GSE pullback. After lenders realized that the GSEs were not immediately coming back into the market – and that the private-label investors did not have such hard-and-fast rules as the GSEs – they would have begun to adjust their pricing and borrowers would have responded to the new pricing.

Figure 5 shows time series for originations of the four mortgage risk characteristics discussed above. The variable on the y axis is the number of mortgages written with the risky characteristic below the conforming loan limit (i.e., GSE-eligible) less those above – the same basis as the difference-in-difference specification used above. The vertical line is at August 2003, the month that the GSE pullback occurred.

Table 5 shows more formal results from the Bai-Perron tests on each of the four time series. The two series that show strong breaks at August 2003 are no/low documentation and ARMs. These have a pronounced break that is also clearly visible in Figure 5. Interest-only (IO) mortgages appear to have increased, but the evidence is not as strong. The BP tests identify a break at August 2003 for IO but this is only accepted by the BIC test; it is rejected by the LWZ test.

It seems reasonable that low-doc loan origination would increase after the GSE pullback – low documentation is one of the mortgage characteristics most vulnerable to fraud, adverse selection, and principal-agent problems. Furthermore, it appears that of the risk attributes that the borrower can select from, lenders charged less for low documentation than for other attributes. For example, Ashcraft and Schuermann (2008) find that the credit enhancement needed for a pool full of low-documentation loans increased by 6 percent from the base rate, lower than for ARMs (+9 percent) or high LTV (+35 percent) (they do not discuss prepayment penalties).

The variable that reacts the least to the GSE pullback is the prepayment variable, despite the increase in ARMs (which are much more likely to have prepayment penalties than FRMs because of their low initial interest rates). The BP procedure fails to identify a structural break occurring after the GSE scandals; only the model with one structural break passes the F-test and the most likely candidate for that break was May 2003. The BP procedure identifies December 2003 as the third-most likely structural break, but the model with three structural breaks does not pass the F-test, even at the 10 percent level.

Table 4 presents the difference-in-difference regression results. The model is

$$\Delta_{i,t} = \alpha_i + \beta_{1,i}T + \beta_2 1(T > 8/03) + \beta_3 T \cdot 1(T > 8/03) + \varepsilon_{i,t}$$

where the variables have the following interpretations:

i indexes the type of risky mortgage characteristic.

Δ is the difference between the number of loans with the characteristic below the limit privately securitized less the number above.

T is a linear time trend

1 is an indicator function

The most important variable is the interaction of the linear time trend and the dummy variable for after August 2003, labeled *Trend * After*. It captures the change in the slope of the line after August 2003 and is significantly positive for low/no doc, ARM, and prepayment penalty. Surprisingly, the sign is negative and significant for interest-only loans. However, as discussed in the following paragraph, I believe that this is an artifact of a later steep drop in interest in IO loans later in the sample period as interest rates increased.

The model with just one break may not be the most accurate. Many of the BP tests identified another structural break – usually trending downward – around late 2005 or early 2006. This could bias downward the estimation of the effect of August 2003. I reran the regressions including two structural breaks: August 2003 and January 2006 (the latter is somewhat arbitrary but designed to capture a general downward trend starting

about that time). The coefficients and t-statistics from the first structural break are also presented in Table 4. Adding the second break markedly improves the fit of the model and the strong upward trend starting in late 2003 is much more apparent. Now the interaction variable is positive and significant for all four variable, including IO.

Restriction to under the conforming loan limit

The difference-in-difference tests presented above have the problem that many borrowers may take on risk in order to borrow more and, in doing so, borrow more than the conforming loan limit in the process, as mentioned before. To counter this problem, I construct a slightly difference-in-difference test, restricted to loans under the limit. The difference is changed to the number of loans with the specified risk characteristic less the number without. This is in some ways a more pure test of how borrower behavior changed after the GSE pullback. The BP tests are presented in Table 5 and regression results in Table 6. In this specification, ARMs and IO loans show the sharpest reaction to the GSE pullback. However, the results are broadly similar to the previous specification.

The role of loan-to-value ratios

I also examine loan-to-value ratios (i.e., a low down payment). However, the average measured loan-to-value ratio actually begins to drop precipitously after late 2003! My hypothesis is that this is due to the presence of “silent seconds,” home equity loans that are issued simultaneously with the first lien mortgage and used for purchase of the property.

The GSEs insist that loans exceeding 80% LTV have mortgage insurance (or in rare cases other types of credit enhancement). A cheaper alternative for borrowers, however, is to borrow 80% of the property’s value in one loan and then obtain a “piggyback” second lien for the rest of the value – borrowing up to 100% of the value or even more in some cases. Unfortunately I cannot test this using the LoanPerformance database, because it does not have data on other liens on the property.

V. Subprime mortgages

Another threshold that I use to examine the GSE pullback is the borrower’s credit (FICO) score. I use a similar difference-in-differences method here, focusing on the threshold of a FICO score of 620 or lower. Although there is no single definition of a “subprime” loan, a 620 FICO is a common definition because borrowers with FICOs that low are generally ineligible for GSE purchase. Salomon Smith Barney (2001) notes that “generally, the minimum FICO score in alt-A lending is 620.”[§] Fabozzi (2006) places the cutoff between 600 and 620 depending on the issuer. In 2007, less than 5 percent of

[§] “Alt-A” borrowers are considered to be prime borrowers in terms of credit score but lack documentation or have other characteristics that do not qualify them for traditional prime status. The important thing for my purposes is that these are distinguished from “subprime” borrowers.

Fannie Mae's book of business had a FICO below 620; most of those mortgages that did had credit enhancement (such as mortgage insurance), and a low LTV. The few that did not – i.e., had particularly risky characteristics – made up less than 1 percent of the book of business and were acquired to meet HUD housing policy goals (Fannie Mae 2007). Keys et al. (2008) use a FICO score of 620 as a “rule of thumb” threshold, and show clearly that such a threshold exists.

This has slightly different dynamics than the previous discussion of risk layering: the FICO score is not one of the borrower's choice variables the way that mortgage amount is; it is the lender's decision whether to lend to an applicant with a certain FICO score. Of course, the borrower's FICO score is endogenous with respect to whether she chooses to apply for a mortgage at all, and a more lax lending environment could encourage people with low FICO scores to apply for mortgages. It is likely that low-FICO borrowers may be more likely to apply for a mortgage if they know that the lender is more likely to accept their application. However, the ultimate decision to accept or deny the application belongs solely to the lender, and this is the basis of the Mian and Sufi (2008) paper.

Figure 7 shows that the GSE pullback did not affect the growth of the subprime market but had a dramatic impact on the Alt-A/jumbo market. The two lines are the difference in privately securitized mortgages below and above the conforming loan limit; the relatively flat line is for borrowers with FICOs below 620 (who would not be eligible for GSE purchase anyway) and the line that jumps sharply is for borrowers with FICOs above 620.

VI. Conclusion

Many commentators on the growth of subprime lending focus on the demand side: a shift in investor preferences. For example, Reinhart and Rogoff (2008) compare purchases of subprime MBS to the loans U.S. banks made to Latin American countries during the 1970s. They argue that the recycling of petrodollars into Latin American loans parallels the recycling of Asian current account surpluses into subprime MBS. Perhaps investors simply succumbed to a Kindleberger-style financial euphoria and were blinded to the risks.

The demand-side explanation is important, but the supply side is also relevant. Had the GSEs continued to buy and securitize mortgages at the pre-scandal rate, a greater segment of the population would have taken out less risky mortgages. It is possible that the house prices would not have grown as fast and that the subsequent financial losses would not be so staggering.

Dell'Ariccia and Marquez (2006) develop a model in which a sudden arrival of borrowers whose risk characteristics are unknown lead to a lending boom. In the model, there are multiple types of borrowers; each bank knows the risk characteristics of one type of borrower. There is another group of borrowers that are opaque to all banks. When the proportion of opaque borrowers is low, a separating equilibrium results, with each bank lending to those borrowers that it knows are good and requiring high collateral levels to

discourage other banks' bad borrowers from borrowing from it. However, when the number of opaque borrowers is high, banks compete with each other and lower their lending standards. This results in a second-best pooling equilibrium and the level of credit in the economy expands dramatically. This model has obvious similarities with the boom of borrowers appearing on banks' doorsteps after the GSEs pulled back in late 2003.

The housing boom had a number of other important facets, most notably the dramatic rise in house prices. Although I speculate that the GSE pullback and subsequent rise in risky lending exacerbated the housing bubble, I do not specifically test for this effect.

My analysis shows that the pullback by the GSEs after the scandals of mid-2003 affected borrower behavior more than lender behavior. This implies that borrowers were capturing at least some of the surplus from the GSE implicit guarantee. Borrowers were implicitly being subsidized to take out low-risk mortgages.

The policy implications of this paper are ambiguous. On one hand, the current crisis might have been shallower had the GSEs not been forced to curtail their activity. On the other hand, the GSEs have major issues in terms of public policy. The interest rate differential that the GSEs receive from the implicit government support accrues in large part to the shareholders (Passmore 2005). Furthermore, because of their size, they pose an important systemic risk (OFHEO 2003). The scandals serendipitously passed a great deal of risk to private investors that would otherwise have been implicitly borne by the taxpayers. This paper clearly shows that the government can encourage certain types of mortgage underwriting, but makes no claims that the existing system of GSEs is the best way to go about it.

VII. Timeline

June 9, 2003	Freddie Mac fires its president, David Glenn, along with two other senior officials.
June 11, 2003	Federal prosecutors begin criminal investigation into Freddie Mac.
July 17, 2003	OFHEO Director Amando Falcon tells the Senate Committee on Banking, Housing and Urban Affairs, that OFHEO plans on conducting a special accounting inquiry into Fannie Mae.
October 29, 2003	Fannie Mae revises the balance sheet data from its earnings release of October 16, 2003, by over \$1 billion
December 18, 2003	OFHEO report on Freddie Mac results in \$125 million penalty and an extensive list of mandatory corrective actions
September 17, 2004	OFHEO releases report on its special examination of Fannie Mae.
December 6, 2006	Fannie Mae says it will reduce its earnings for 2002, 2003, and the first half of 2004 by more than \$6 billion.

Sources: Washington Post (2004), Associated Press (2006), OFHEO (2004), other news and official reports.

VIII. References

- Agarwal, S., Driscoll, J., & Laibson, D. (2007). Optimal Mortgage Refinancing: A Closed Form Solution. NBER Working Paper 13487.
- Ambrose, B., Lacour-Little, M., & Sanders, A. (2004). "The Effect of Conforming Loan Status on Mortgage Yield Spreads: a Loan Level Analysis." *Real Estate Economics*, 32(4).
- Angell, C., & Rowley, C. (2006). Breaking New Ground in U.S. Mortgage Lending. *FDIC Outlook*.
- Ashcraft, A. B., & Schuermann, T. (2008). Understanding the Securitization of Subprime Mortgage Credit. *Federal Reserve Bank of New York Staff Reports*.
- Bai, J. (1997). Estimation of a Change Point in Multiple Regression Models. *The Review of Economics and Statistics*, 79(4).
- Bai, J. & Perron, P. (1998), "Estimating and Testing Linear Models with Multiple Structural Changes," *Econometrica*, 66.
- Bai, J. & Perron, P. (2003). Computation and Analysis of Multiple Structural Change Models. *Journal of Applied Econometrics*, 18.
- Blinder, Alan S., Mark J. Flannery, and G. B. Lockhart. 2006. "New Estimates of the Jumbo-Conforming Mortgage Spread." Unpublished working paper.
- Carlton, D. W., Gross, D. B., & Stillman, R. B. (2002). The Competitive Effects of Fannie Mae. *Fannie Mae Papers*, 1(1).
- Chomsisengphet, S., & Pennington-Cross, A. N. (2006). The evolution of the subprime mortgage market. *Federal Reserve Bank of St. Louis Review*.
- Coleman IV, M., Lacour-Little, M., & Vandell, K. D. Subprime Lending and the Housing Bubble: Tail Wags Dog? Unpublished working paper.
- Dell'Ariccia, G., & Marquez, R. (2006). Lending Booms and Lending Standards. *The Journal of Finance*, 61(5), 2511-2546.
- Demyanyk, Y., & Van Hemert, O. (2008). Understanding the Subprime Mortgage Crisis. Unpublished working paper.
- DiMartino, D., & Duca, J. V. (2007). The Rise and Fall of Subprime Mortgages. *Economic Letter-Insights from the Federal Reserve Bank of Dallas*, 2(11).
- Doms, M., Furlong, F., & Krainer, J. (2007). *Subprime Mortgage Delinquency Rates*. Federal Reserve Bank of San Francisco Working Papers.
- Elliehausen, G., Staten, M. E., & Steinbuks, J. (2008). The effect of prepayment penalties on the pricing of subprime mortgages. *Journal of Economics and Business*, 60(1-2).
- Fabozzi, Frank J. (2006). *The Handbook of Mortgage-Backed Securities*. McGraw-Hill Professional.

- Fannie Mae (2007). *Discussion of Credit Book of Business*. Fannie Mae Investor/Analyst Conference Call, August 16, 2007.
- Frame, W. S., & White, L. J. (2005). Fussing and Fuming over Fannie and Freddie: How Much Smoke, How Much Fire? . *Journal of Economic Perspectives*, 19(2).
- Gerardi, K., Shapiro, A. H., & Willen, P. S. (2007). *Subprime Outcomes: Risky Mortgages, Homeownership Experiences, and Foreclosures*. Federal Reserve Bank of Boston Working Papers.
- Harrison, David M., Thomas G. Noordewier, and Abdullah Yavas. 2004. "Do Riskier Borrowers Borrow More?" *Real Estate Economics* 32(3).
- Lehnert, A., Passmore, S. W., & Sherlund, S. M. (2006). *GSEs, Mortgage Rates, and Secondary Market Activities*. Federal Reserve Finance and Economics Discussion Series.
- Keys, Benjamin J. et al. 2008. "Did Securitization Lead to Lax Screening? Evidence from Subprime Loans." Unpublished working paper.
- Mian, Atif R., and Amir Sufi. "The Consequences of Mortgage Credit Expansion: Evidence from the 2007 Mortgage Default Crisis." NBER Working Paper 13936.
- Office of Federal Housing Enterprise Oversight (OFHEO) (2003). Systemic Risk: Fannie Mae, Freddie Mac, and the Role of OFHEO.
- Office of Federal Housing Enterprise Oversight (OFHEO) (2004). Report of Findings to Date: Special Examination of Fannie Mae.
- Olszowy, A. (2006). Alternative Mortgages: Managed Risk or Gamble? *Communities & Banking*, Federal Reserve Bank of Boston.
- Passmore, W. (2005). The GSE Implicit Subsidy and the Value of Government Ambiguity. *Real Estate Economics*, 33(3).
- Pennington-Cross, A. (2002). Subprime Lending in the Primary and Secondary Markets. *Journal of Housing Research*, 13(1).
- Rogoff, K., & Reinhart, C. (2008). "Is the 2007 U.S. Sub-Prime Financial Crisis So Different? An International Historical Comparison." NBER Working Paper 13761.
- Salomon Smith Barney (2001). *Salomon Smith Barney Guide to Mortgage-Backed and Asset-Backed Securities*. Wiley Finance.
- Vickery, J. I. (2007). Interest Rates and Consumer Choice in the Residential Mortgage Market. Unpublished working paper.
- Timeline: Fannie Mae. (October 8, 2004). *The Washington Post*.
- Fannie Mae Chronology. (May 23, 2006). *The Associated Press*.

IX. Figures

FIGURE 1: MORTGAGE ORIGINATION BY CHANNEL
Financing source, percent of total mortgage originations

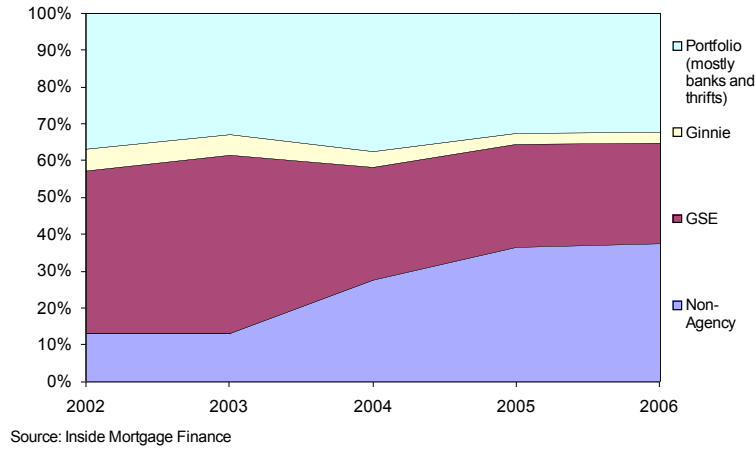


FIGURE 2: PRIVATELY-SECURITIZED LOANS: DIFFERENCE ABOVE AND BELOW LIMIT

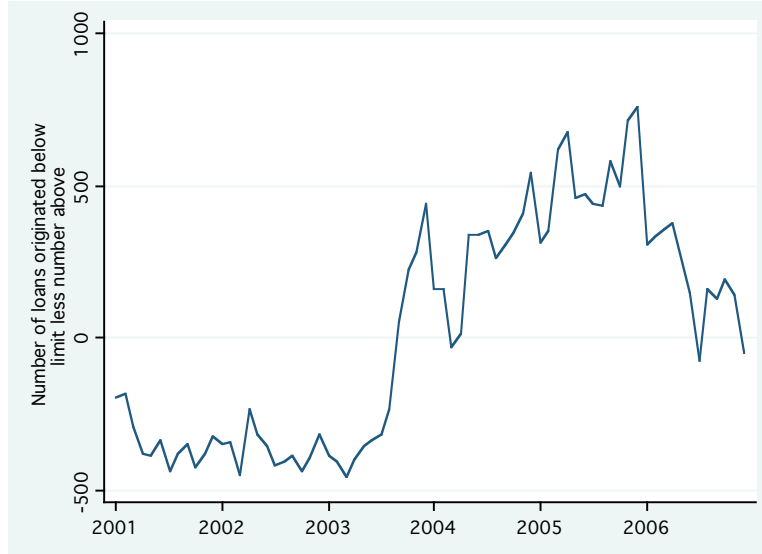


FIGURE 3: GSE MBS ISSUANCE

Issuance of MBS.

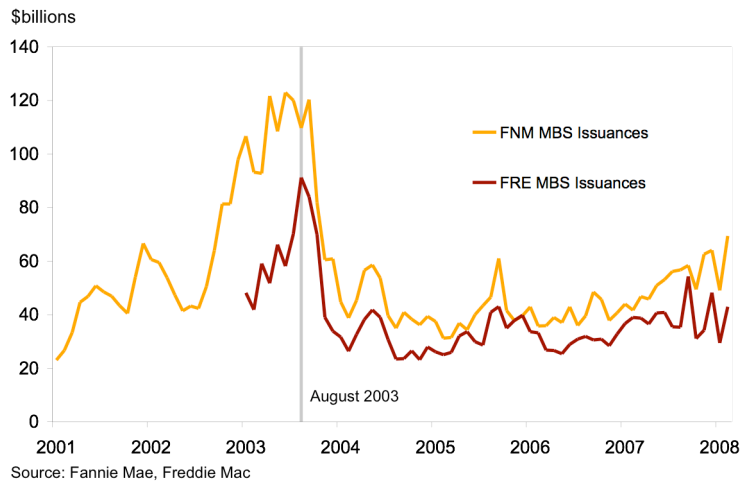


FIGURE 4: MORTGAGES RETAINED ON GSE PORTFOLIOS

Mortgages retained on GSE portfolios.

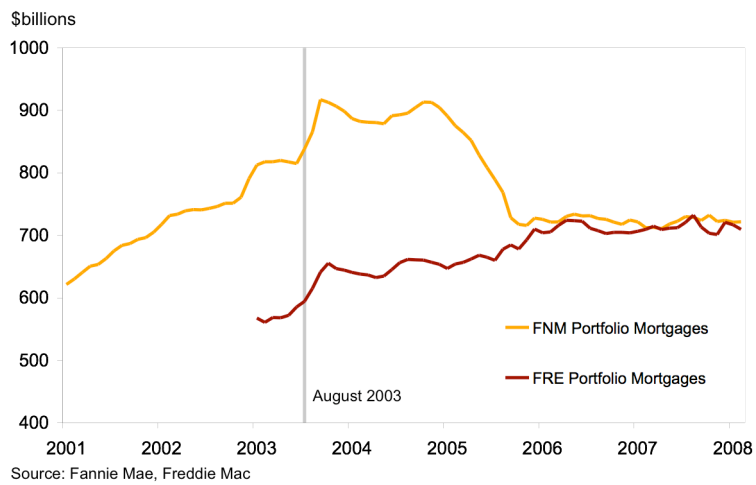


FIGURE 5: RISKY LOANS, ABOVE/BELOW THE LOAN LIMIT

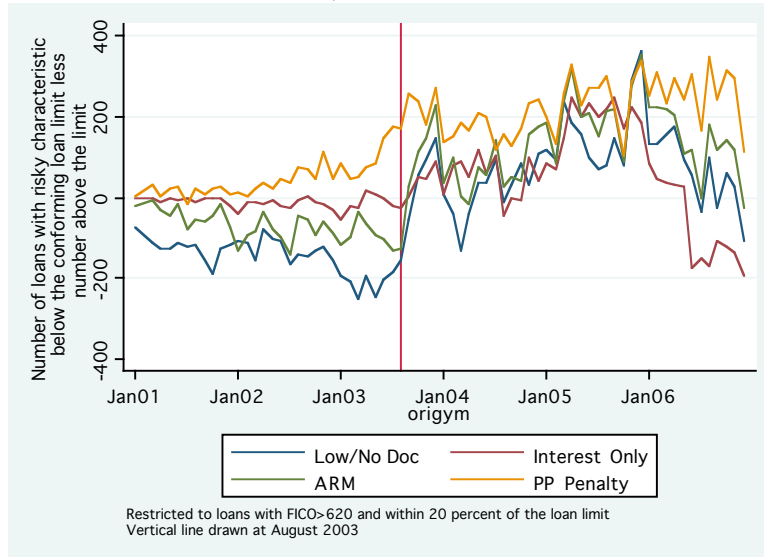


FIGURE 6: LOANS BELOW THE LIMIT, WITH AND WITHOUT RISKY CHARACTERISTICS

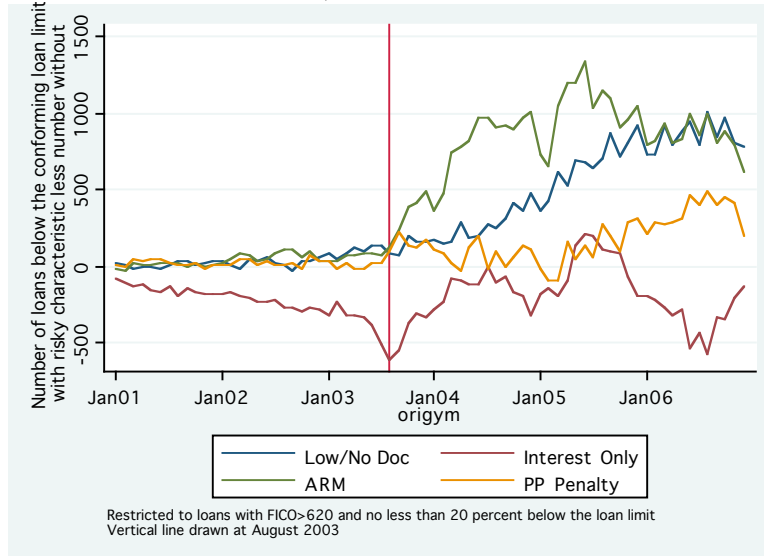
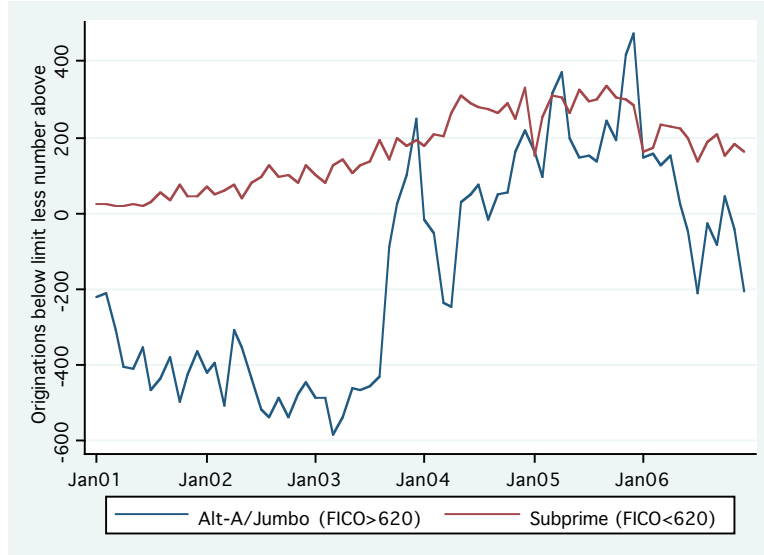


FIGURE 7: HIGH-FICO vs. LOW-FICO (SUBPRIME), ABOVE/BELOW LIMIT



X. Tables

TABLE 1: CONFORMING LOAN LIMITS

Year	1 unit	2 units	3 units	4 units	Second liens
2000	\$252,700	\$323,400	\$390,900	\$485,800	\$126,350
2001	\$275,000	\$351,950	\$425,400	\$528,700	\$137,500
2002	\$300,700	\$384,900	\$465,200	\$578,150	\$150,350
2003	\$322,700	\$413,100	\$499,300	\$620,500	\$161,350
2004	\$333,700	\$427,150	\$516,300	\$641,650	\$166,850
2005	\$359,650	\$460,400	\$556,500	\$691,600	\$179,825
2006	\$417,000	\$533,850	\$645,300	\$801,950	\$208,500

Source: Office of Federal Housing Enterprise Oversight (OFHEO)

Table 2: Private-Label Securitizations: Diff-in-Diff

Number of loans originated				
Time trend	30.10*** (17.81)	0.03*** (18.14)	0.02*** (3.94)	0.01 (1.93)
After 8/03	7835.43*** (3.37)	15.29*** (13.61)	4.56 (0.98)	4.93 (0.81)
Below loan limit	-355.34*** (-13.73)	-0.56*** (-16.31)	-0.56*** (-16.30)	-0.55*** (-7.44)
After * below	675.97*** (7.00)	0.75*** (17.53)	0.74*** (17.59)	0.74*** (8.80)
After * trend	-14.77*** (-3.43)	-0.03*** (-13.76)	-0.01 (-1.07)	-0.01 (-0.88)
6-month LIBOR			-0.58*** (-7.32)	-0.52*** (-4.49)
1-year interest rate swaps			0.62*** (6.75)	0.54*** (4.20)
Conventional mortgage rate			-0.34*** (-8.21)	-0.31*** (-5.00)
Log OFHEO HPI				1.20*** (7.40)
12-month change in OFHEO HPI				1.28 (1.16)
Constant	-14400.80*** (-16.83)	-13.75*** (-14.56)	-4.65 (-1.75)	-7.87* (-2.24)
State dummies	No	Yes	Yes	Yes
Month dummies	No	No	Yes	Yes
N	144	6073	6073	6073
r2	0.824	0.743	0.749	0.753

* p<0.05, ** p<0.01, *** p<0.001

t-statistics in parentheses. Standard errors calculated using Huber-White correction. Sample restricted to origination amounts within 20 percent of the conforming loan limit. Standard errors clustered by quarter in fourth column regression

TABLE 3: BAI-PERRON TESTS - ABOVE AND BELOW THE LIMIT

# breaks selected by...	Risk layering characteristic			
	No/Low Doc	IO	ARM	Prepayment Penalty
BIC	2	3	3	2
LWZ	2	3	3	1
Aug. 03 one of the break points?	No	No*	Yes	Yes

* Dec. 2003 is one of the break points.

Restricted to borrowers with FICO>620 and loan amounts within 20 percent of the conforming loan limit. Loans may have more than one of the risky characteristics and would be counted under each type.

TABLE 4: DIFF-IN-DIFF: RISKY MORTGAGES ABOVE AND BELOW THE LOAN LIMIT

	Type of risky mortgage attribute			
	Low or no Documentation	Interest only	ARM	Prepayment Penalty
----- Number of loans originated -----				
Trend	-3.37*** (-5.54)	-0.38 (-1.35)	-2.47*** (-5.41)	-0.93 (-0.81)
After	-2404.96** (-2.87)	1808.12* (2.17)	-2115.95** (-2.89)	-1474.42 (-1.89)
Trend * After	5.06** (3.23)	-3.18* (-2.05)	4.44** (3.26)	3.25* (2.16)
Constant	1564.10*** (5.11)	182.77 (1.28)	1181.45*** (5.13)	433.86 (0.75)

N	72	71	72	72
r2	0.702	0.218	0.706	0.831

Results from regression including another break point at January 2006 - only first break point variables displayed				
After	-5951.94*** (-4.64)	-4266.86*** (-8.04)	-5006.01*** (-4.57)	-2367.86* (-2.30)
Trend * After	11.69*** (4.87)	8.18*** (8.23)	9.84*** (4.81)	4.92* (2.51)

r2	0.826	0.809	0.806	0.843

t-statistics in parentheses. Standard errors calculated using Huber-White correction. Regression restricted to borrowers with FICO > 620 and loans within 20 percent of the conforming loan limit.

TABLE 5: BAI-PERRON TESTS – PRESENCE OF RISKY MORTGAGE CHARACTERISTICS,
BELOW THE CONFORMING LOAN LIMIT

# breaks selected by...	Risk layering characteristic			
	No/Low Doc	IO	ARM	Prepayment Penalty
BIC	2	3	3	1
LWZ	2	1	2	0
Aug. 03 one of the break points?	Yes	Yes*	Yes	No

* Aug. 2003 is the third break point selected: it is significant using the BIC but not the LWZ test.

Restricted to borrowers with FICO>620 and loan amounts within 20 percent of the conforming loan limit. Loans may have more than one of the risky characteristics and would be counted under each type.

TABLE 6: DIFF-IN-DIFF – CONFORMING MORTGAGES
WITH AND WITHOUT RISK CHARACTERISTICS

	Type of risky mortgage attribute			
	Low or no Documentation	Interest only	ARM	Prepayment Penalty
----- Number of loans originated -----				
Trend	3.52*** (6.50)	-10.86*** (-6.81)	3.16*** (7.78)	0.08 (0.12)
After	-10627.35*** (-12.96)	-4814.09** (-2.90)	-2595.47 (-1.41)	-4613.72*** (-4.86)
Trend * After	20.27*** (13.19)	9.68** (3.11)	6.04 (1.79)	8.77*** (4.99)
Constant	-1749.86*** (-6.42)	5273.12*** (6.57)	-1560.16*** (-7.61)	-17.82 (-0.06)

N	72	71	72	72
r2	0.953	0.197	0.863	0.619

Results from regression including another break point at January 2006 – only first break point variables displayed

After	-13621.69*** (-13.15)	-13517.54*** (-6.53)	-12461.94*** (-5.39)	-1148.44 (-0.78)
Trend * After	25.86*** (13.35)	25.97*** (6.65)	24.50*** (5.69)	2.29 (0.83)

N	72	71	72	72
r2	0.968	0.595	0.933	0.704

* p<0.05, ** p<0.01, *** p<0.001

t-statistics in parentheses. Standard errors calculated using Huber-White correction. Regression restricted to borrowers with FICO > 620 and loans between 0 and 20 percent less than the conforming loan limit.